121

IRL Library

Joshua Lederberg

Stretching Out the Period Of the Brain's Development

According to traditional teaching, the brain has reached its full complement of neurons, or nerve cell units, at the time of birth. Indeed, the human brain only quadruples its weight from birth to maturity, compared to a twentyfold increase for the whole body. And most of the brain's growth is an obvious increase in white matter, the connections and fibers that course among the neurons.

This theory has helped support the doctrine that a child's intelligence is in principle predestined by his genes. But very few professional geneticists in fact believe this, notwithstanding the unarguable examples of serious genetic diseases of mental development. Most of us have concluded that the genetic make-up is decisive in the child's pattern of response to his own environment, which may be more or less well matched to his genes.

We have a long way to go in our efforts to sort out the most pertinent elements of such environments, like pre- and post-natal infection and nutrition, preschool nurturing and family stimulation, styles of classroom teaching, sources of self-image and so on. Even the serious genetic diseases will respond to the right environments, when we eventually learn enough about the biochemistry of the developing brain to know what to prescribe.

NOW THE traditional doctrine has been challenged headon by Dr. Joseph Altman of the Psychophysiology Laboratory of the Massachusetts Institute of Technology. His experiments are summarized in a chapter of a magnificent compendium, "The Neuroscience," recently issued by the Rockefeller University Press.

Historically, neurons undergoing division were hard to find, and to distinguish from other kinds of cells, when brain tissue was examined under the microscope. Dr. Altman therefore used a newer approach that relies upon modern knowledge of DNA, the genetic material in cell nuclei, and its building blocks, including the substance thymine.

Thymine can be prepared in a radioactive form without altering its chemical or biological properties. When injected into an animal, it is bound to cells only by the process of DNA synthesis. Under these conditions, therefore, the presence of radioactivity in a cell is a very clear signal of DNA synthesis and cell division.

IN A NUTSHELL, Dr. Altman has obtained good evidence for the continued multiplication of neurons in young rats or kittens, especially in a region of the brain called the hippocampus. Other evidence suggests that the hippocampus helps to stabilize recent experience into long-term memory.

It will not be easy to extend such experiments to man, but they will undoubtedly shed important light on the biology of intelligence, more directly than any other program of external observation.

Dr. Altman's most recent finding, published in Developmental Psychobiology magazine, concerns the effect of intentionally handling or playing with young rats for just 15 minutes daily during their first 11 days of life. At 14 days, the rats that had been handled had slightly smaller brains. But at six weeks, they had 20 per cent more radioactively labeled cells than the undisturbed controls.

These results suggest that handling has stretched out the period of active development of the brain, the infantile period which is longer in man than in any other species.

The main point we have to ponder is the complicated interplay between the environmental experience of the rat (or human infant?) and the development of the actual structure of his brain.

A more bizarre speculation, concerns the possibility of "brain transplantation" which is properly regarded as the reduction to an absurdity of the whole concept of human restoration by organ transplant. If, however, certain cells in the brain can continue to proliferate after birth, isolated cells might be successfully transplanted into one brain from another individual or another species.

Such experiments would make it possible to test the theory (which I support) that memory and personality are reflected in the patterns by which neurons become interconnected, rather than the contents of the individual cells.

The Oak Ridger
10/28/68